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METHOD FOR DISTRIBUTING HYDROGEN WITH SAFETY MEASURES  
[PROCEDE DE DISTRIBUTION D'HYDROGENE AVEC MESURE DE SECURITE]

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## Method for distributing hydrogen with safety measures

The present invention concerns the distribution of industrial hydrogen, especially in heat treatment applications such as sheet steel annealing, of the type in which one has hydrogen storage available, liquid hydrogen for example that is vaporized on demand that one takes by means of a system of pipes to the facility where it will be used.

Along with the expansion of the use of gases, some of which are dangerous, it sometimes has been necessary to take drastic measures for the sake of safety, especially in the electronics industry, where one uses alarm devices that detect any leak of a toxic gas. But such safety measures cannot be implemented at certain heavy industry sites, as is the case of heat treatment of steel, because these facilities do not lend themselves, due to their greatly increased dimensions, to the installation of hydrogen leak detectors.

On the other hand, in the case of natural gas distributed by networks to residential or industrial facilities, one adds an odoriferous product to this natural gas that is used exclusively for combustion, which allows one to alert the user in case of accidental leaks. However, although hydrogen gas is also quite often distributed by a network to different industrial users, there are

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\* Numbers in margin indicates pagination of foreign text.

factors that argue against applying to this kind of hydrogen distribution safety measures that are effective in the distribution of natural gas to residential installations, because certain applications, whose promoters are dissuaded from employing these hydrogen distribution networks, involve gases, especially hydrogen, in a state of high purity, as is the case in the electronics industry.

It is the principal merit of the present invention to have discerned that the problem of hydrogen distribution safety occurs under very different conditions in many applications where hydrogen is taken, not from a distribution network with many users, but from individual storage facilities, if necessary in liquid state in order to be vaporized on demand, which are positioned at the site of use itself and where the industrial user can himself, if the application lends itself to it, add an odoriferous product, upstream from the supply pipes, such as a mercaptan, thiophane or a product known by the name "TEM."

It is particularly important to note that, specifically in metal annealing heat applications, it has already been suggested that one /2 add some hydrogen sulfide, at rates of 0.5 to 50 ppm, to the annealing atmosphere comprised then of nitrogen with 3 to 6% hydrogen, as Nippon Steel Corporation Ltd. mentions in its Japanese patent 73-59021 of November 21, 1971 (see the summary of this patent in CIT No. 9, 1977, pages 2113 to 2117). But this addition of

hydrogen sulfide to the oven atmosphere had the exclusive goal of eliminating the formation of graphitization points on the surface of the sheets. Indeed, this document proposes adding a graphitization inhibitor in gaseous form to the oven atmosphere. And of course, at this level of intervention, the hydrogen sulfide is dissociated or in any case eliminated in a safe and thorough manner from the oven by being ejected via the chimney flue or by being broken down by combustion.

Thus, this prior proposal, which is an exclusively technical effect, is complemented according to the present invention by an arrangement that, by providing for the addition to the hydrogen of an odoriferous product as far upstream as possible in the hydrogen distribution pipeline, allows one to assure, in addition to the anti-graphitization effect known from the aforementioned publication, the safety of the distribution of hydrogen at the storage and use site, exactly where this security, alarmingly, is lacking.

As was mentioned earlier, the addition of an odoriferous product is done as far upstream as possible. Also, if all the uses of hydrogen storage lend themselves to the use of a not strictly pure hydrogen gas, one places the odoriferous agent addition apparatus directly at the "vapor" outlet from the storage unit. On the contrary, if one or several applications of the storage facility hydrogen turn out to be incompatible with the use of a hydrogen gas that incorporates, even in small amount, an odoriferous product, then

one places the odoriferous product addition apparatus in the area of the separation of the supply pipes of the utilization facilities that involve pure hydrogen, away from those that supply the units that lend themselves to the use of hydrogen with even a small content that is, however, detectable by any human operator working at this odoriferous product site.

One should note that the risks of hydrogen leaks do exist particularly at the various connections between the supply pipes and the storage unit, between the pipes themselves, and between the pipes and the units that use them. An annealing oven in particular has /3 different hydrogen injection points staggered along the height or along the periphery of the objects to be annealed inside the oven, and one should note that the proposal according to the invention allows one to detect leaks in the area of the unit itself, while the proposal known from the Japanese patent 73-59021, which consists of introducing the hydrogen sulfide separately in an annealing oven directly avoids any possibility of hydrogen leak detection in the area of the oven.

#### CLAIMS

1. Method of industrial hydrogen distribution, especially for heat treatment of metals, such as annealing, of the type in which one has a hydrogen storage unit available, especially for liquid hydrogen, at the use site where one vaporizes the hydrogen on demand, the said hydrogen being delivered by a system of pipes to the unit

where it will be used, characterized in that one adds, upstream from the piping system that serves units capable of using a hydrogen gas that is not strictly pure, an odoriferous gaseous product, such as mercaptan or thiophane, or a product known by the name "TEM."

2. Industrial hydrogen distribution method according to Claim 1 characterized in that at a site of hydrogen use, which employs applications that must involve pure hydrogen and other applications that lend themselves to the use of hydrogen impregnated with an odoriferous product, one adds the said odoriferous product upstream from the pipes that supply the said applications that lend themselves to hydrogen impregnated with an odoriferous product.